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(54) PRESSURE RELIEF VALVES AND PACKAGING CONTAINER INCORPORATING THEM

(71) We, HAG AKTIENGESELLSCHAFT, a body corporate organised according to the laws of the Federal Republic of Germany, of Hagstrasse, 28 Bremen 1, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to pressure-relief valves and to packaging containers incorporating such valves suitable for holding contents which emit gas during storage, more especialy roasted coffee.

It is known that roasted coffee when packed in commercial packaging will generally retain its fresh aroma for only about 8 to 10 weeks. Then an aging process sets in, oxygen-catalyzed condensation and polymerization reactions taking place, possibly with the formation of peroxides in small quantities which impart a sensorially undesired note to the coffee aroma and taste.

Attempts have therefore been made in various ways to develop coffee packaging in which there remains no more than a minimum of oxygen, such packaging forms being, for example, hermetic vacuum hard packs, hermetic soft packs evacuated and subsequently filled with a shielding gas, vacuum cans, etc. While in the case of ground coffee improvements were achieved thereby, with coffee in whole bean form the problem of slow CO_2 regassing from the beans occurred. The rason is this: In the roasting process, besides the formation of the brown color and of the coffee aroma, much CO_2 is released, which for the most part is included in the roasted beans. This gas, which amounts to a multiple of the bean volume (Lit.: R. Radtke et al: Kaffee & Tea Markt *25* (17), 7-14 (1975)), diffuses out of whole beans slowly in preponderant degree during the first two or three weeks and causes an undesirable bloating of the hermetic packing. With ground coffee, this effect is practically no longer observable, as the CO_2 is much more rapidly released from the roasted coffee during the grinding process.

The attempt has been made, therefore, to solve the problem of the gradual CO_2 desorption in roasted beans by using vacuum cans which are designed to withstand an increased internal pressure, or by welding CO_2-adsorbing substances, packed in small polyethylene sacs, into the laminate foil which serves as packaging material, or by using a mechanical valve which opens at a certain CO_2 pressure and can be welded into a gasproof package in known manner.

The operational safety of such pressure relief valves has been improved before by using in support of the valve effect, a liquid layer of high cohesive force as has been known for a long time, in greased ground valves. In an arrangement known from German laid-open application OS 2,360,126, a rubber disk serving as valve element lies on a valve seat which, like the rubber disk, is coated with a silicone oil film. The disk type valve body can lift off its valve seat only when the internal pressure present in the package has overcome the sum of the elastic reaction of the valve body and the adhesive force of the viscous intermediate layer between the valve body and valve seat. As small pressure forces are not sufficient to release the adhesive force of the viscous intermediate layer, the pressure relief valve opens only at a certain excess pressure, so that the deflection of the valve element is relatively great and therefor a certain period of time passes before upon cessation of the excess pressure, the valve element has again approached the valve seat to the extent that, due to the viscous intermediate layers, joint action of the adhesive forces occurs again and thus complete tightness exists again, preventing any undesired access of gas, e.g., air.

The object underlying the present invention is to provide a pressure relief valve which responds to and operates at very small overpressure, thereby reducing the danger that during the interval between abatement of the overpressure and the re-

newed joint action of the viscous forces, a gas exchange such as air incursion occurs in an undesired direction, i.e., into the interior of the container incorporating the valve.

The present invention provides an assembly of a pressure relief-valve carried on a wall structure, the assembly comprising a wall structure having passage means extending therethrough, a valve unit carried on said wall structure and in communication with the passage means therein, and a covering member disposed over said valve unit and connected with said wall wall structure, said covering member having openings therein with said valve unit being operable to allow gas flow through said passage means and the said covering member openings, said valve unit comprising a porous element impregnated with a chemically stable liquid which is of relatively low volatility and insensitive to oxygen, to provide a gas flow blocking layer of said liquid in the pores of said element, the said porous element being fixed around its periphery and in sealed relationship between the said covering member and the said wall structure or a further covering member in sealed relationship therewith, the arrangement being such that, in operation, the presence of gas pressure on one side of the assembly in excess of a predetermined value ruptures the liquid layer in the pores of said element whereby gas flow occurs through said element, the liquid layer in said pores being restored when the gas pressures on that side of the assembly reduces at least to said predetermined value.

The present invention also provides a packaging container for holding contents which emit gas while stored therein, a part of the wall structure incorporating an assembly as defined above.

As a result of this design, the pressure relief valve responds readily at low overpressure which overpressure would not be sufficient for the effective and proper mechanical actuation of a valve element coated with a viscous layer.

Two forms of pressure-relief valve assembly in accordance with the invention incorporated in packaging containers will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows a transverse section through a first form of packaging container to which the valve unit is applied directly; and

Figure 2 shows a transverse section through a second form of packaging container, with which the valve unit is connected as an independent assembly.

With reference to Figure 1, a valve element 3 consists of a porous element which is impregnated with a liquid and is pirhepherally fixed between the container wall 1 and a covering 6 consisting of a foil or a molding. This is effected for example by a peripheral adhesive layer or weld seam 4 situated between the valve element and container wall or by an adhesive layer or weld seam 4' between the valve element and covering 6. The surface layer 1a of the container wall preferably constitutes the inner face of the package or container, but may alternatively form the outer face. In the zone of the valve, the container wall 1 is provided with perforations 2, which have for example a diameter of about 1 mm, and the covering 6 has perforations 7. The valve element 3 may, if desired, be designed so that it is spaced a small distance as at 8 or 9 from the covering 6 of the container wall 1. At 10 the container wall 1 is heat-sealed or glued to the covering 6. The adhesive layers or weld seams 4 and 4' may be used simultaneously instead of alternatively.

Filter paper is especially suitable as valve element, but also elements of porous ceramic, such as sintered glass grains (glass frit), pressed kieselguhr, sintered metal and foamed plastics material may be used, likewise glass fiber mats, synthetic fabrics and air-permeable large-pored artificial leather.

It is especially advantageous if the valve element 3 which serves as a carrier for the liquid can be welded onto the wall of the packaging container or, referring to Fig. 2, onto an intermediate foil or covering such as is shown at 12 in that Figure. If, for instance, the porous element 3 consists of thick filter paper that can be fixed by a heat-sealed connection onto a polyethylene container wall or intermediate member.

As liquid for the impregnation of the valve element are suitable all liquids of great cohesive force or high surface tension, which have little volatility, are insensitive to oxygen, non-hygroscopic and chemicaly stable, have little solubility for O_2 and practically no odour of their own. Examples of such liquids include silicone oil, olive oil, peanut or bone oil, also mineral oils and certain plasticizers such as dioctyl, dinonyl, didecyl phthalates or sebacic acid esters. The viscosity should be approximately between 3 and 12 Engler degrees at 20degC.

The overpressure at which the valve opens depends on the surface tension of the carrier liquid and the mean pore diameter of the carrier material according to the equation $p=2\ gamm/R$, where gamma is the surface tension and R the mean pore diameter of the carrier material. By variation of the liquid as well as by alteration of the porosity of the carrier the opening

pressure of the valve can be varied. At CO overpressure in the interior of the packing container, the pressure relief valve responds at a certain pressure difference, the liquid in the pores "ruptures", the valve opens, and after pressure equalization the liquid layer in the pores is restored and blocks the passage of gas.

Example

A filter paper having a weight of 350 g/m² and a filtration time according to the Herzberg testing system of 80 seconds is used, has a diameter of about 2 cm, a thickness of 0.9 mm and is impregnated with silicone oil of about 2000 cSt/20deg. The pressure relief valve opens at a pressure of 15 mbar and closes at about 10 mbar.

In the embodiment shown in Fig. 2, the pressure relief valve may be used as a separate valve assembly 5 in which the valve element is enclosed at each of its two sides by a foil or molding. Such a valve assembly 5 may be provided on the inside or on the outside of the package or container. In Fig. 2, the surface layer 1a constitutes preferably the inner face of the package or container provided with perforations 2. On its face toward the container wall 1, the valve assembly 5 may be provided with a shallow recess 11 which facilitates the passage of the gases from the interior of the packaging container to the atmosphere.

To facilitate the passage of gas, the valve element 3 may be at a small distance 8 or 8' from the covering 6 or the molding 12 and is hermetically connected with the molding or mounting strip 12 and/or the covering 6 by an adhesive or sealing connection 4 or 4'.

The covering 6 and molding 12 of the valve assembly 5 are hermetically interconnected by a heat sealing 13, while the valve assembly 5 as a whole is connected with the container wall by a sealing 10. Such heat sealings could alternatively be replaced by adhesive connections.

The covering 6 is provided with a number of perforations 7, and the molding 12, which as mentioned may consist alternatively of a foil, with a number of perforations 7', whereby the arrangement can operate in accordance with that of Fig. 1.

The pressure relief valve provided according to the invention is suitable especially for packaging containers into which coffee in whole bean form is filled immediately after roasting, although also other applications, for example for the packing of cheese, have advantages.

To test a container equipped with the pressure relief valve in accordance with the invention, coffee in whole bean form was packed immediately after roasting, the container was evacuted, and thereafter a regassing both with nitrogen and with carbon dioxide was effected. The packed produce was subjected to a sensor test at intervals of 4 weeks for a period of 6 months. An equally fresh roasting aroma was always noted.

The function of the valve is explained by the capillary effect. Upon a certain overpressure being reached, the liquid layer is ruptured by the gasoverpressure because the pressure forces are greater than the cohesive forces acting between the liquid particles. After pressure equalization, the capillaries formed in the liquid layer are closed again by the surface forces.

WHAT WE CLAIM IS: —

1. An assembly of a pressure-relief valve carried on a wall structure, the assembly comprising a wall structure having passage means extending therethrough, a valve unit carried on said wall structure and in communication with the passage means therein, and a covering member disposed over said valve unit and connected with said wall structure, said covering member having openings therein with said valve unit being operable to allow gas flow through said passage means and the said covering member openings, said valve unit comprising a porous element impregnated with a chemically stable liquid which is of relatively low volatility and insensitive to oxygen, to provide a gas flow blocking layer of said liquid in the pores of said element, the said porous element being fixed around its periphery and in sealed relationship between the said covering member and the said wall structure or a further covering member in sealed relationship therewith, the arrangement being such that, in operation, the presence of gas pressure on one side of the assembly in excess of a predetermined value ruptures the liquid layer in the pores of said element whereby gas flow occurs through said element, the liquid layer in said pores being restored when the gas pressure on that side of the assembly reduces at least to said predetermined value.

2. An assembly as claimed in claim 1, wherein the porous element is fixed around its periphery by an adhesive connection.

3. An assembly as claimed in claim 1, wherein the porous element is fixed around its periphery by a heat-sealed connection.

4. An assembly as claimed in any one of claims 1 to 3, in which the said liquid is selected from silicone oil, olive oil, peanut oil, bone oil, mineral oil and plasticizers.

5. An assembly as claimed in any one of claims 1 to 4, in which the said liquid has a viscosity in the range of from 3 to 12 Engler degrees at 20°C.

6. An assembly as claimed in any one

of claims 1 to 5, in which the porous element comprises filter paper.

7. An assembly as claimed in any one of claims 1 to 6, in which the valve unit is embodied in a self-contained assembly comprising a porous element impregnated with said liquid and having a covering member disposed on each side, said covering members having openings therein and being in sealed connection one with the other, said porous element being fixed around the periphery thereof to the inner surfaces of said covering members, and one of said covering members being fixed to the wall structure.

8. An assembly of a pressure-relief valve carried on a wall structure, substantially as hereinbefore described with reference to, and as shown in Figure 1 or Figure 2 of the accompanying drawings.

9. A packaging container for holding contents which emit gas while stored therein, a part of the wall structure of said container incorporating an assembly as claimed in any one of claims 1 to 8.

10. A container as claimed in claim 9, in which the valve unit is disposed at the outer surface of the wall structure.

11. A container as claimed in claim 9, in which the valve unit is disposed at the inner surface of the wall structure.

12. A packaging container for holding contents which emit gas while stored therein, substantially as hereinbefore described with reference to, and as shown in, Figure 1 or Figure 2 of the accompanying drawings.

13. A packaging container as claimed in any one of claims 9 to 12, containing roasted coffee.

14. A packaging container as claimed in any one of claims 9 to 12, containing unground roasted coffee.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

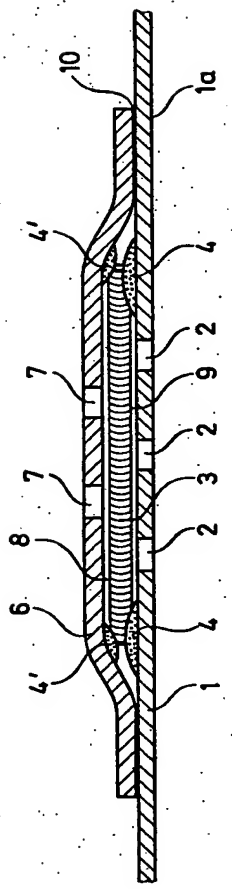

FIG. 2